

# The Harvesting of Microalgae through the Co-Culture with Fungi for Biodiesel Production



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## Introduction

As global warming and oil dependence are becoming more of a concern, solutions in the form of renewable alternative energies are being explored. One promising energy solution is algae based biofuel. Algae biofuel is promising because many strains of algae are able to accumulate high amounts of lipids and are able to thrive in a variety of environments. However, the collected algae must be dried for biofuel production, and current methods of collecting and drying the oleaginous microorganisms are time consuming and energy intensive.

The purpose of this study is to understand the process of copelletization, which is a new energy efficient method of collecting algae with fungi cells. The study focused on determining the chemical environment in which the copelletization process occurs most efficiently. It was found that a combination of an iron source, a calcium source and a nitrogen source are vital for the process to occur. Further research is necessary to fully understand the roles of these nutrients in the harvesting process.

## Benefits of Algae Biofuel

- Some species of algae can accumulate up to 50% of oil/lipid mass per dry weight.<sup>1</sup>
- The amount of oil produced by efficient algae, per acre per year, is up to 31 times more than for terrestrial crops.<sup>2</sup>
- Algae grows in a variety of environmental conditions. And thus could be produced, as a feedstock, all over the world.



Photo credit to treehugger.com



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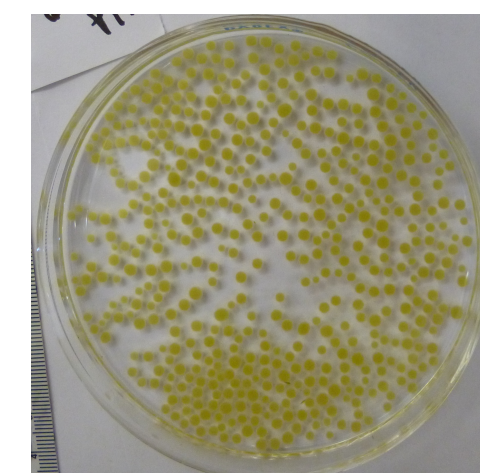
## Materials and Methods

A matrix of media compositions was created, designed to be able to pinpoint the effect of each nutrient by selectively eliminating one or more nutrients for each consecutive medium.

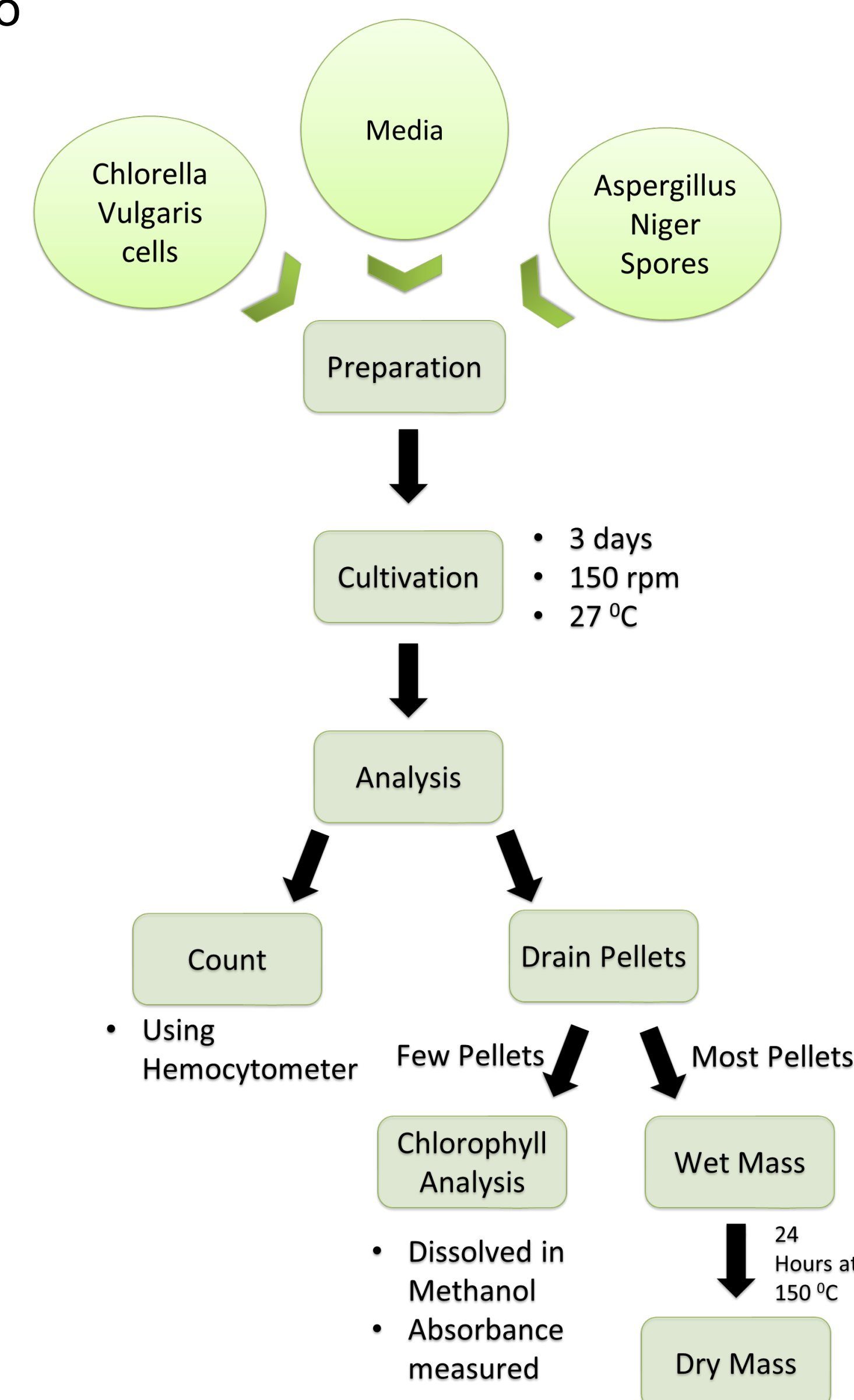
Compound	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Glucose	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
KNO3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
KH2PO4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
K2HPO4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cs	x	x	x					x		x				x		x
Fe	x	x	x						x	x						x
Yeast extract	x	x					x	x						x	x	
Peptone												x				
Urea													x			
Trace metals	x															

For each media fourteen microenvironments were created in separate 250 mL Erlenmeyer flasks filled with 100 mL of solution. Seven were cultivated in the presence of light and seven without.

- Three flasks for Co-pellets
- Two - Algae Controls
- Two - Fungi Controls

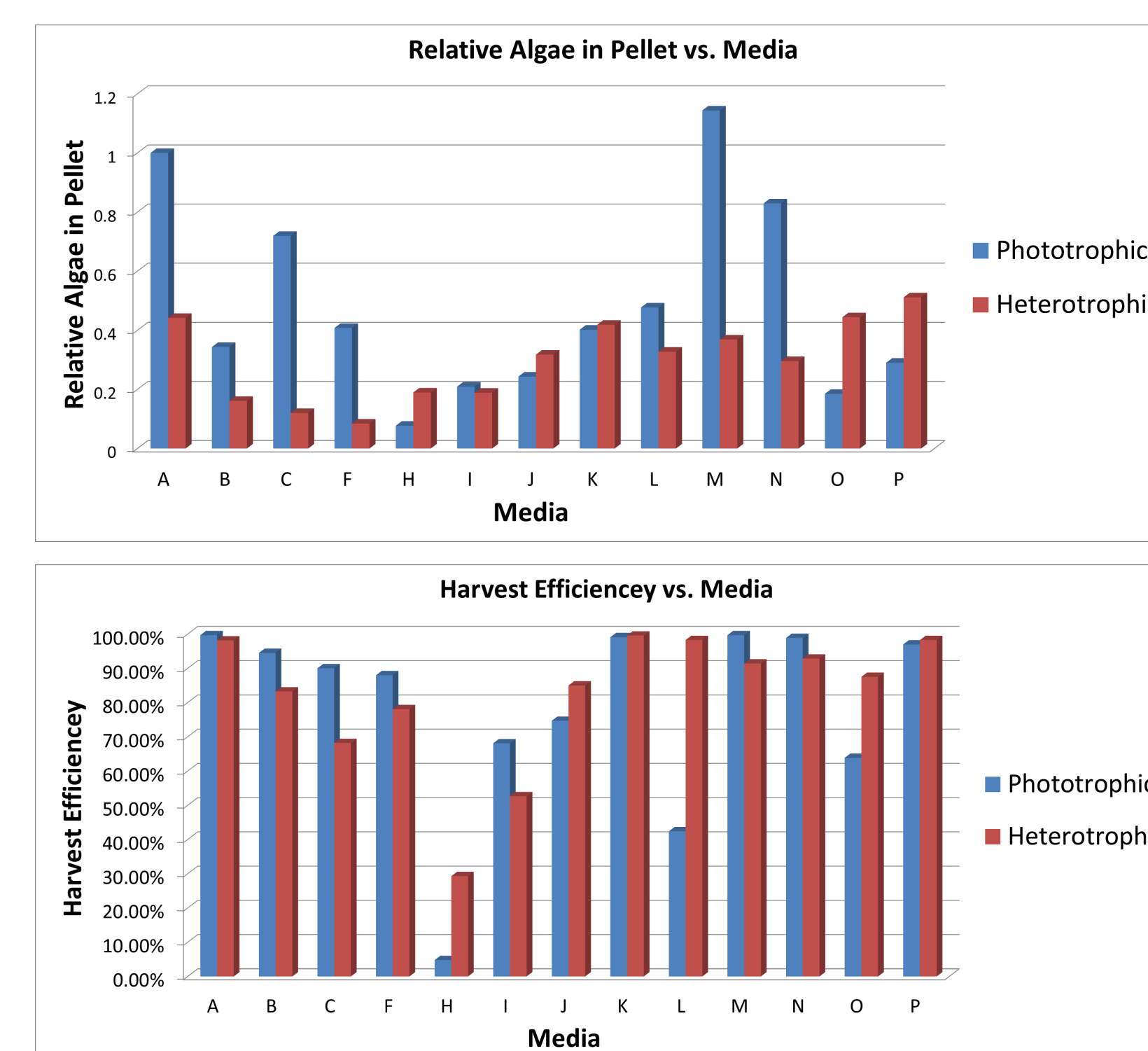


The parameters measured were the harvest efficiency (percentage of algae captured by the pellets) and the amount of algae captured by the pellets. To determine the amount of algae captured by the pellets a few pellets were collected and broken using glass beads in the presence of methanol to release the chlorophyll. The absorbance of the chlorophyll solution was taken and compared to a standard curve, comparing the absorbance of chlorophyll to the dry weight of algae.



## Results

- The amount of algae in pellet results were taken relative to the amount of algae in pellet produced by phototrophic media A because the tests were split up into three batches and Media A was run each time as a control.
- Copelletization was observed in every media, except media D and E.
- Media G samples were deemed unfit because they were cultivated for a longer period then the other Media samples and data from these samples was not considered.
- Media M in phototrophic conditions had the largest amount of algae in the pellets



## Conclusions

From the data available it is reasonable to conclude that the presence of **at least one of the following: Calcium, Iron, and Yeast Extract (Nitrogen), is necessary for the algae filled pellets to form.** This may suggest that these three nutrients are especially important for fungi growth and or for the attraction of the algae to the fungi.

Another interesting occurrence was that the **amount of algae captured by the pellets was always higher in phototrophic conditions compared to heterotrophic conditions, except when yeast extract was not present.** This may suggest that the yeast extract is vital for fungi, and thus pellet formation and growth, when the algae is able to grow fast, as they are in phototrophic conditions.

Because of the amount and complexity of the data collected, conclusions about the specific role of each nutrient in the copelletization process could not be determined.

## Further Studies

- The effect of other important factors like the age of the culture, process conditions like temperature and pH should be studied.
- More strains of algae and fungi should be tested to see if the copelletization process will occur in more oleaginous strains of algae and fungi.

## Bibliography

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- Ayhan Demirbas, M. Fatih Demirbas, (2011). Importance of Algae Oil as a Source of Biodiesel. Energy Conversion and Management, 52(1), 163-170